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TRIVARIATE RESEARCH

HOW TO BUILD THE OPTIMAL PORTFOLIO

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BACKGROUND AND RESEARCH CONCLUSIONS

Background: Over the last few months, we have written two research notes on portfolio beta. The first ([The Higher The Beta The Lower The Alpha](#)) examined the enormous historical alpha destruction from a higher beta portfolio and identified that when the annual performance of the S&P500 is less than 12% actively reducing beta was prudent. The second note ([What's The Right Beta For Your Portfolio?](#)) found the “efficient frontier” of a portfolio-level beta, identifying the optimal portfolio beta for three common approaches--minimum volatility, maximum Sharpe ratio, and maximum return. We concluded that the optimal beta ranges between 0.95 and 1.0, with the maximum Sharpe portfolio at 0.97 on average over the last 25 years. There are several ways a portfolio manager could construct such a portfolio. For instance, an overall portfolio-level beta can be achieved by owning only stocks with extreme betas (in the top and bottom decile), or from a tighter band of individual stock betas near the center of the distribution. **Today's research examines how to construct an “optimal” portfolio by assessing the distribution of betas.**

Methodology: We simulated 100 portfolios each month over the last six years, choosing 60 cap-weighted stock portfolios at random from various deciles of beta. D1 means the lowest decile of beta, D2 the second lowest, and D10 the highest beta decile. For the Top 500 stocks by market cap, each beta decile has 50 stocks. In a portfolio constructed from only high and low beta stocks, a D1-D10 combination, we chose 60 stocks at random, 100 different times each month, and studied their subsequent 12-month forward returns. We then compared this to the results from choosing stocks from the 2nd and 9th beta decile (D2D9), to D3D8, D4D7, and so on.

S&P500 results: Portfolios with extreme beta (D1D10 or D1D2D9D10) had the highest return, and those derived exclusively from stocks with closer to median beta, performed worst. **S&P500-index portfolio managers should actively look to own stocks with extremely high and low beta over average beta stocks, even though the overall portfolio beta should on average be less than 1.0.**

INVESTMENT CONCLUSIONS

Value: We wondered if the results we obtained for the S&P500 would hold if we just analyzed value stocks. The results were DIFFERENT. Value portfolio managers should worry less about how they distribute the beta of their stocks, as the overall performance difference between extreme and average betas was low, and in absolute terms, the best performing portfolio was comprised of stocks in the 4th and 7th beta decile – the opposite result from the overall S&P500.

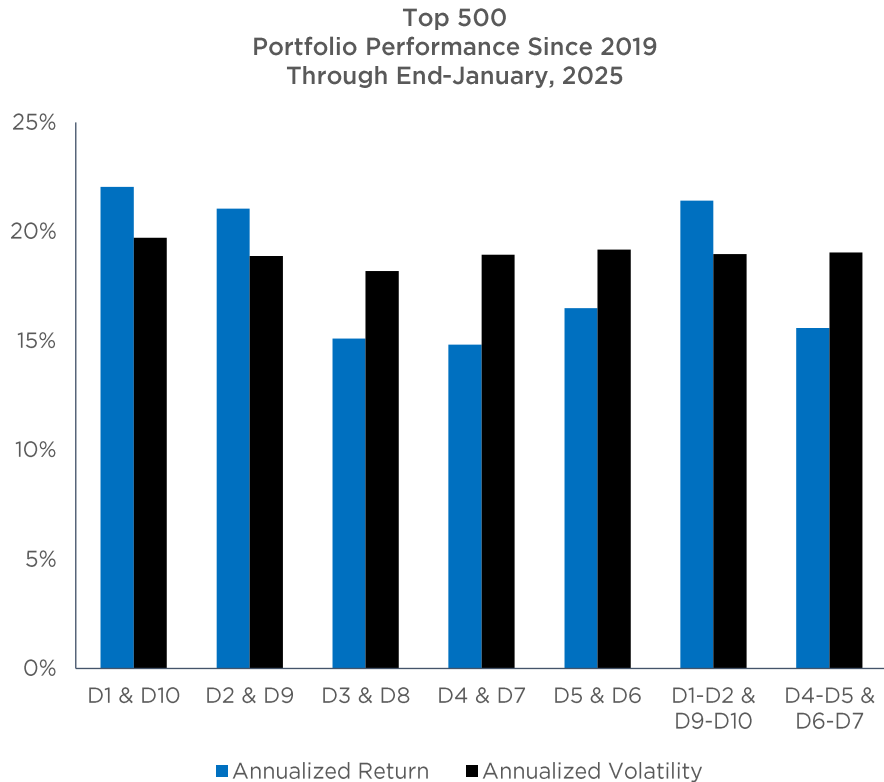
Growth: The growth PM results were quite different from value. Overall returns from extreme beta portfolios were clearly higher, and with higher hit rates. Owning a portfolio taken from D1-D2-D9-D10 was strongest, and materially higher than those simulated from D4-D7 stocks. Hit rates were also highest among growth stocks with extreme betas. It appears extreme betas are good for growth managers and that influences the S&P500-focused portfolios, but value PMs should care less about the distribution overall and focus more on the center than the tails.

Small caps: In addition to analyzing the distribution of betas for the overall market, and then separately for value and growth stocks, we also wanted to assess how this analysis worked for small cap stocks. The results are quite different. Overall, the resulting portfolios show far lower returns and higher volatility than for large caps, with the worst performing portfolios being those comprised only of stocks in D1-D10. However, D2-D9 beta stocks created the 2nd best portfolios, perhaps meaning the distribution of betas was not as meaningful for small cap stocks. Nonetheless, avoiding the extreme deciles is clearly important, a stark contrast to large caps.

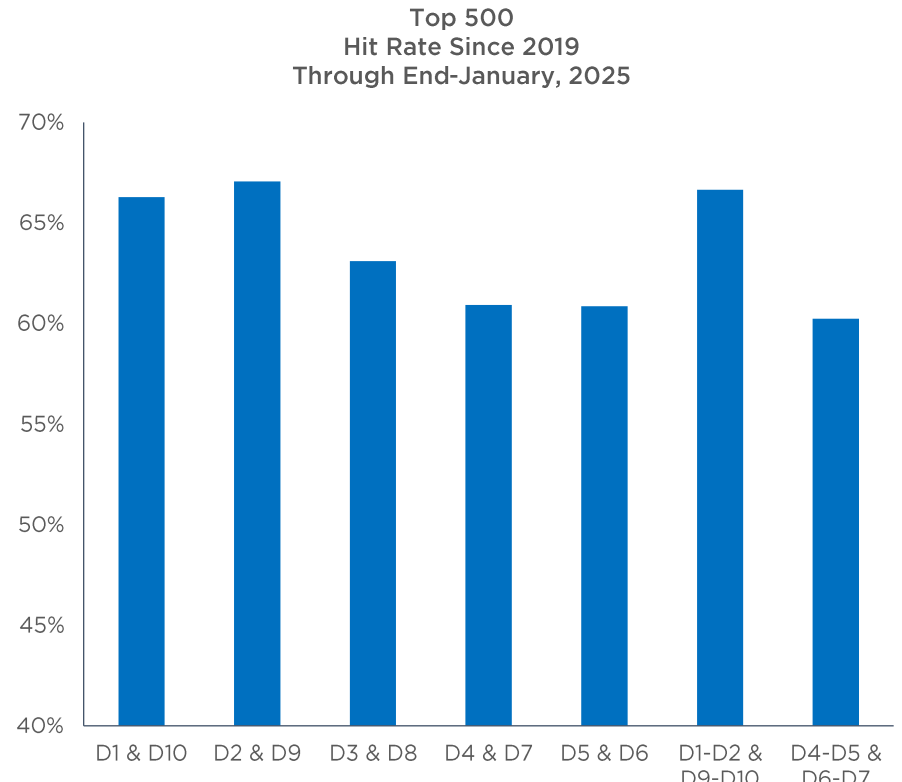
In summary, for S&P500 focused long-only portfolio managers, reducing your portfolio beta after two strong market years makes sense. The optimal portfolio beta is less than 1. Forming your portfolio from stocks balanced between low and high betas is more prudent than from all average beta stocks. To implement change, know what decile each stock's beta is in, and size accordingly.

CONSTRUCTING A PORTFOLIO WITH EXTREME BETAS IS BEST

We simulated 100 portfolios each month over the last six years, choosing 60 cap-weighted stock portfolios at random from various deciles of beta. D1 means lowest decile of beta, D2 second lowest, and so on, with D10 the highest beta decile. For the Top 500 stocks by market cap, each beta decile has 50 stocks. In a portfolio constructed from only high and low beta stocks, a D1-D10 combination, we chose 60 stocks, 100 different times each month, and studied their subsequent 12-month forward returns. We then compared this to the results from choosing stocks from the 2nd and 9th beta decile (D2D9), to D3D8, D4D7, and so on. For the top 500 stocks (left), portfolios with extreme beta (D1D10 or D1D2D9D10) had the highest return, and those derived exclusively from stocks with closer to median beta, performed worst. Choosing a portfolio with stocks that have both very high and low betas also created portfolios with higher monthly hit rates (right).



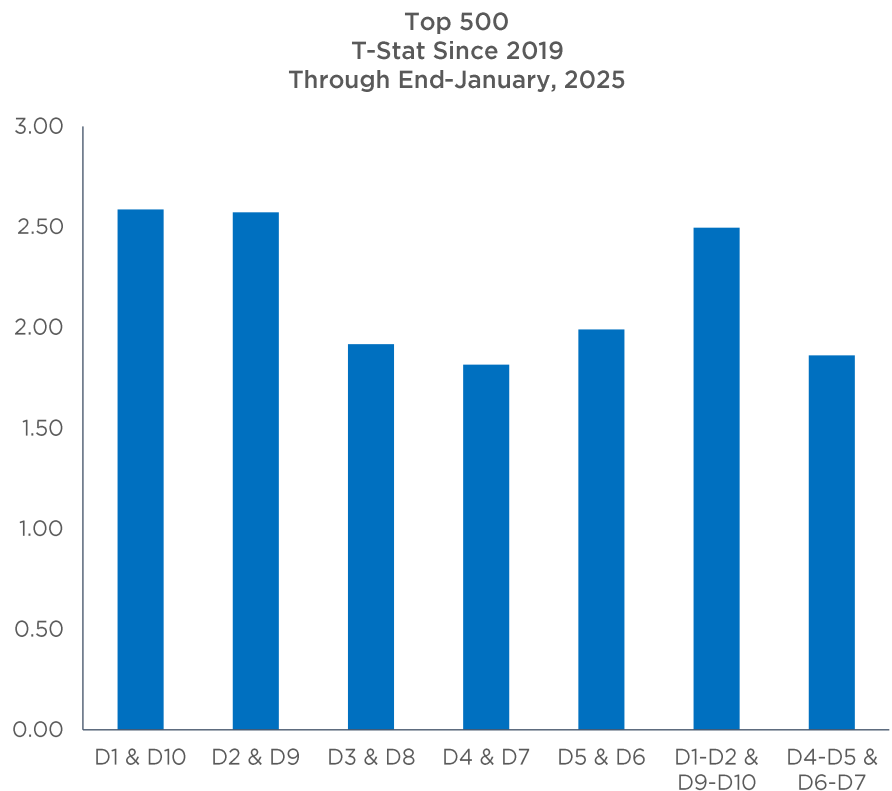
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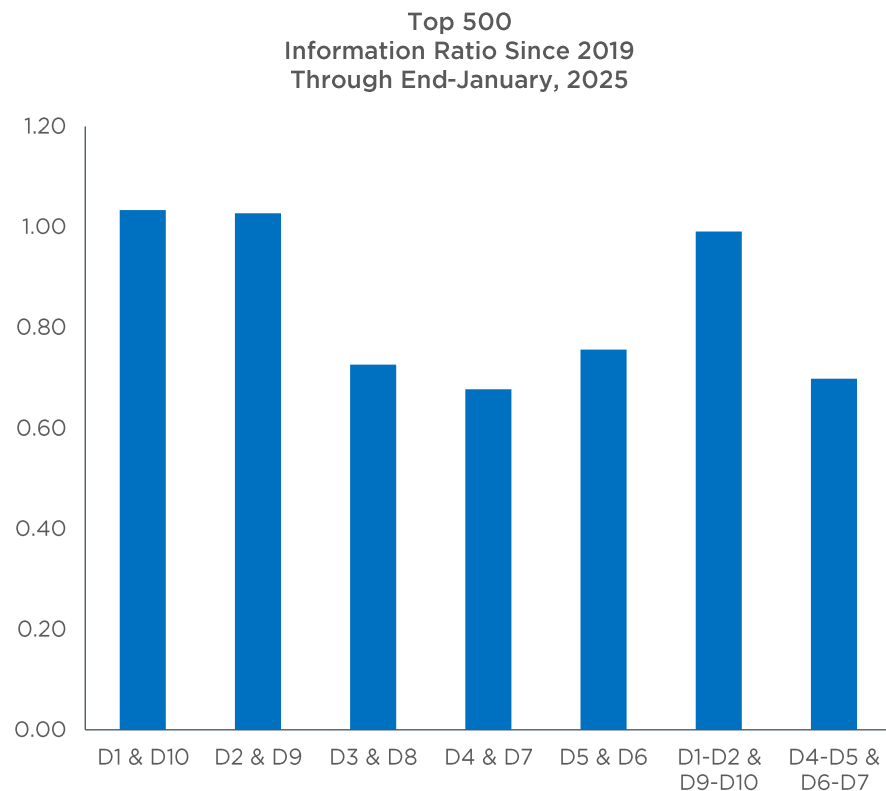
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EXTREME BETA STOCKS RESULT IN HIGHER T-STATS AND INFO RATIOS

Constructing portfolios from stocks with more extreme than average betas results in statistical significance (left), and in higher Information Ratios (right).



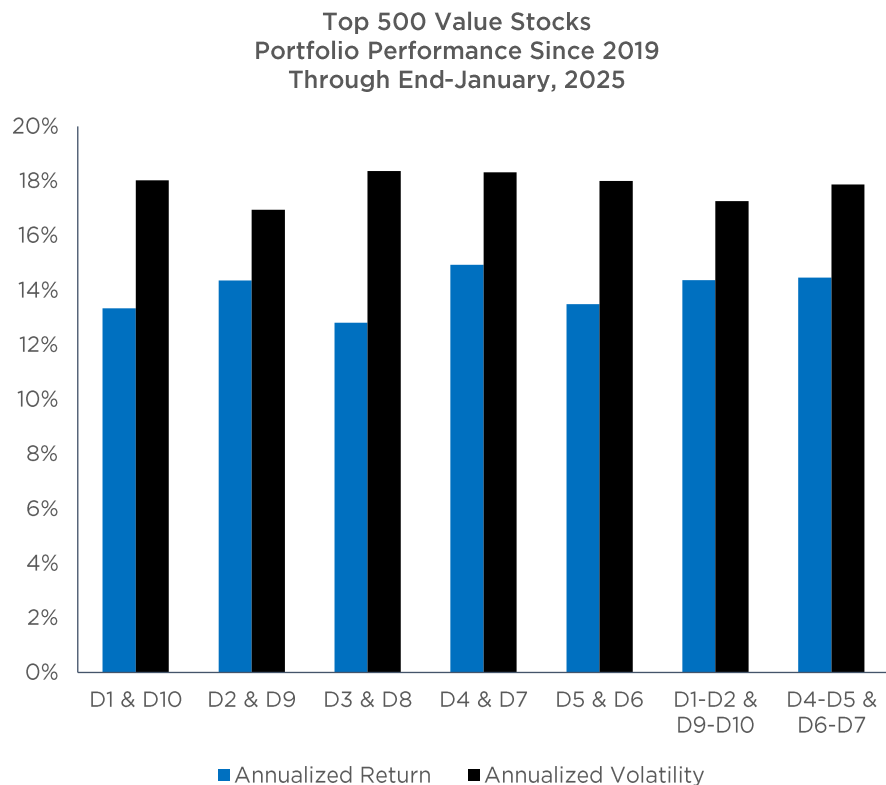
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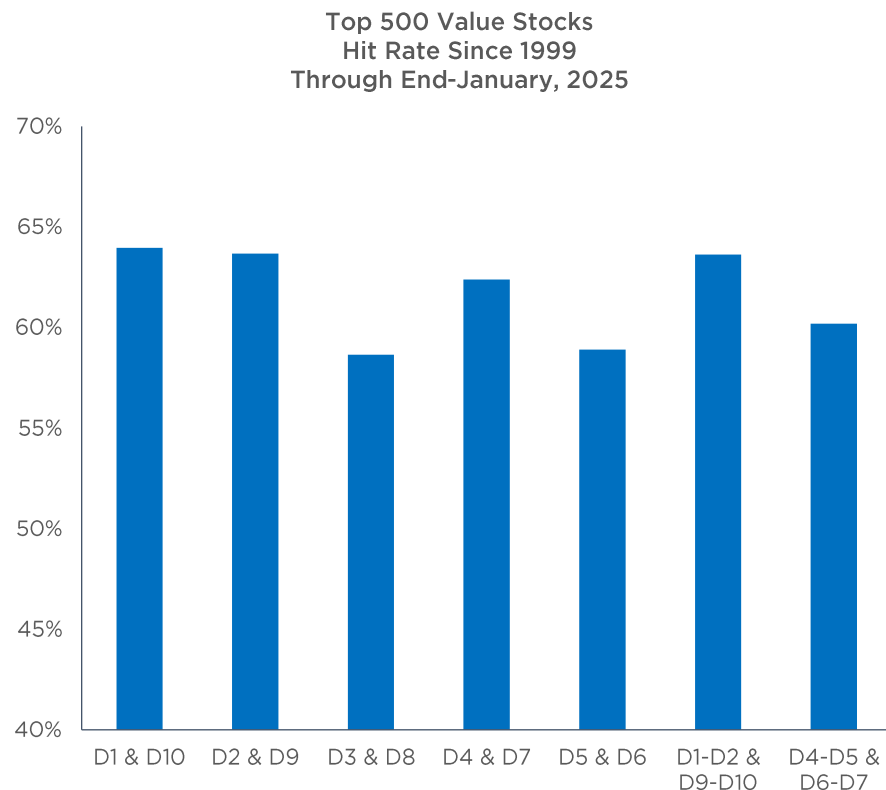
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VALUE PMS SHOULD WORRY ABOUT HOW TO DISTRIBUTE BETAS LESS

We wondered if the results we obtained for the overall S&P500 would hold if we just analyzed value stocks. The results were DIFFERENT. Value portfolio managers should worry less about how they distribute the beta of their stocks, as the overall performance difference between extreme and average betas was low, and in absolute terms, the best performing portfolio (left) was comprised of stocks in the 4th and 7th beta decile – the opposite result of the broader market. Hit rates were all consistent but were highest for the tails (right).



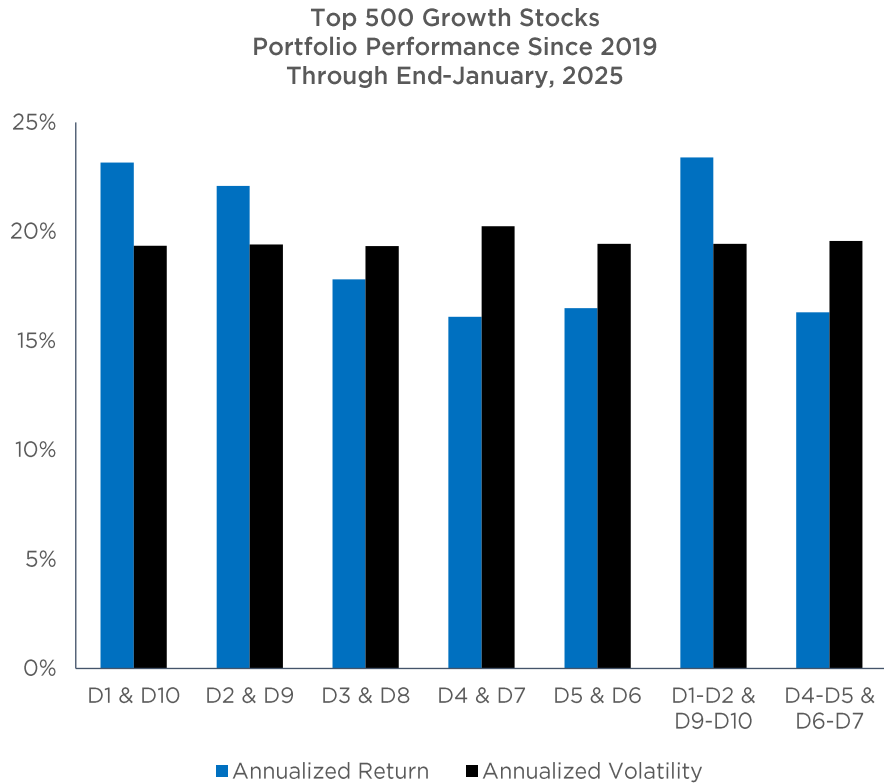
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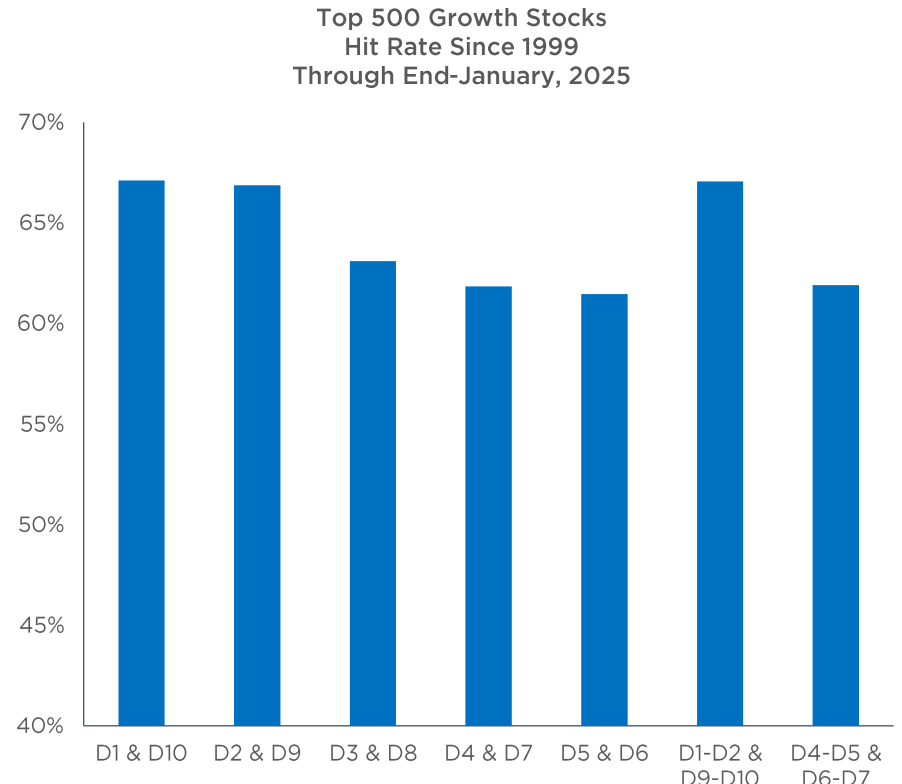
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EXTREME BETAS OUTPERFORM AMONG GROWTH STOCKS

The growth PM results were quite different from value. Overall returns from extreme beta portfolios were clearly higher, and with higher hit rates. Owning a portfolio taken from D1-D2-D9-D10 was strongest, and materially higher than those simulated from D4-D7 stocks (left). Hit rates were also highest among growth stocks with extreme betas (right). Hit rates were also highest among growth stocks with extreme betas (right).



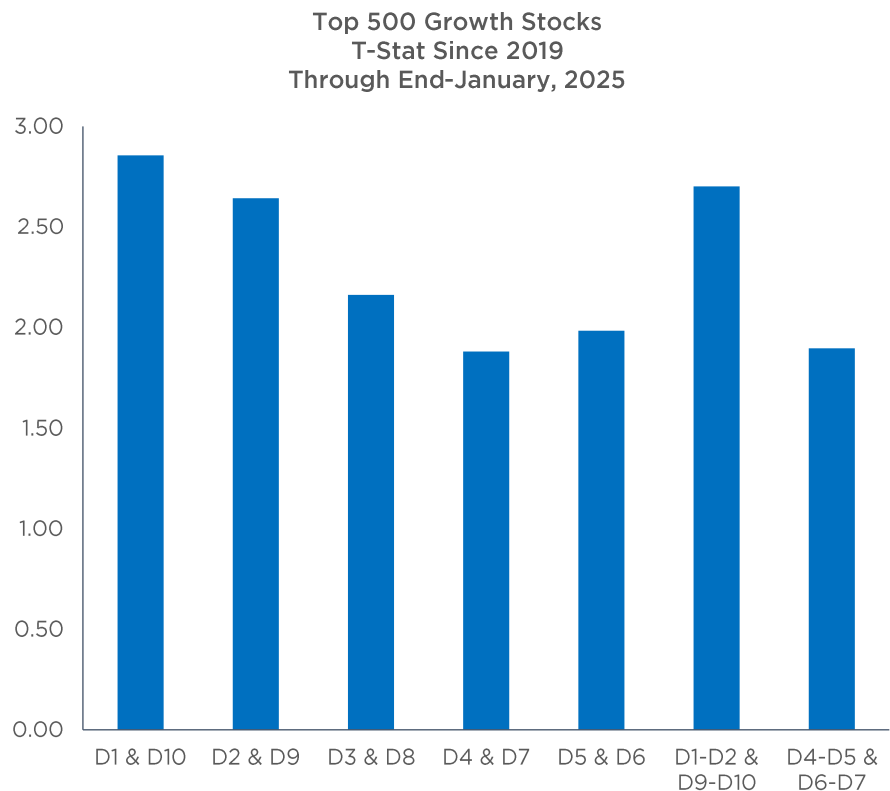
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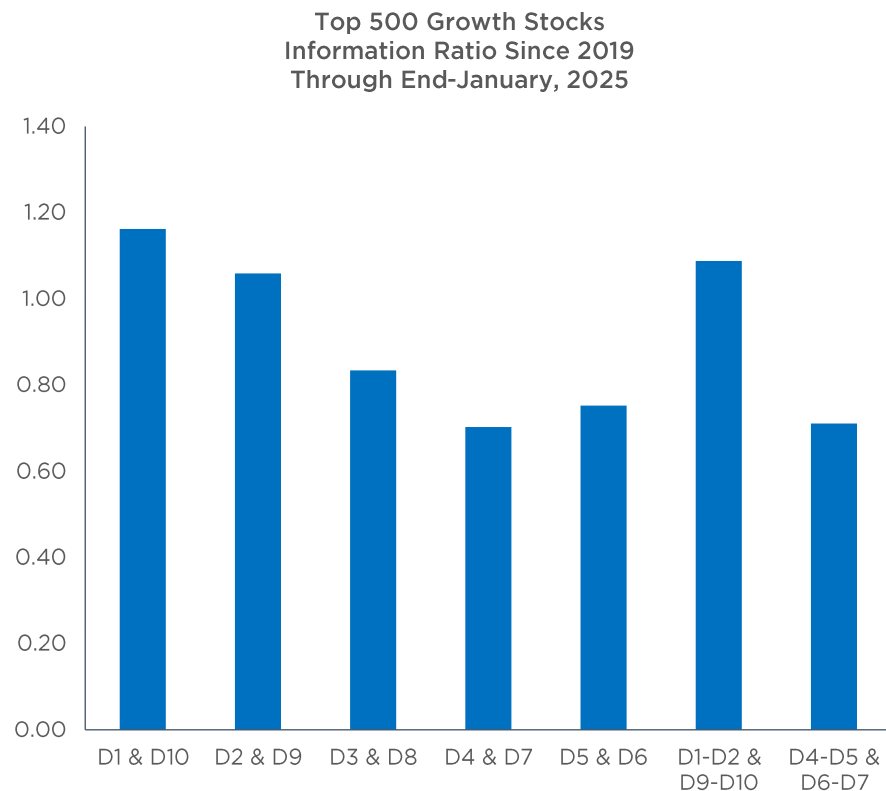
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FOR GROWTH STOCKS, THE IR IS 2X AS HIGH FOR EXTREME BETAS

Among growth stocks, the t-statistics associated with extreme beta portfolios are statistically significant (left), with information ratios nearly twice as high as those comprised of stocks with closer-to-average betas (right).



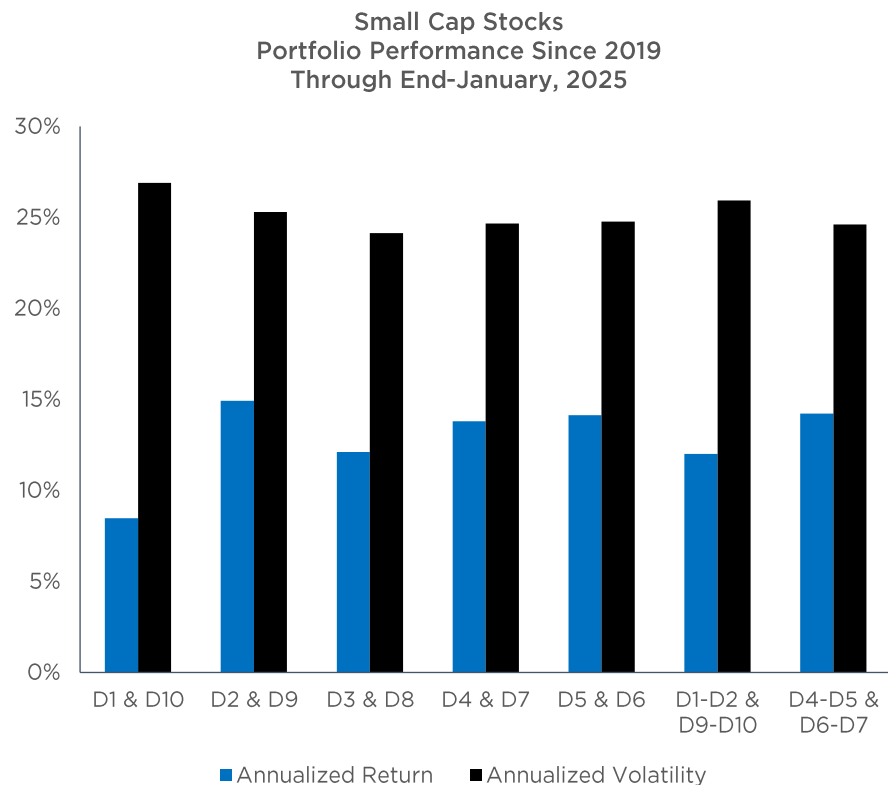
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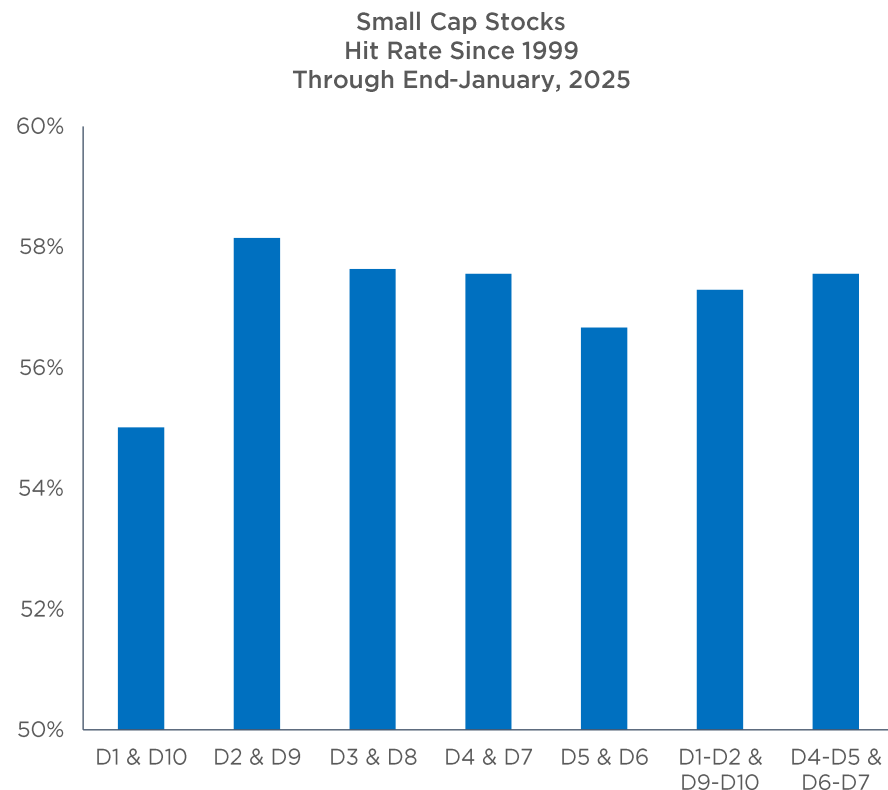
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AVOIDING EXTREME DECILES IS PRUDENT IN SMALL CAPS

In addition to analyzing the distribution of betas for the overall market, and then separately for value and growth stocks, we also wanted to assess how this analysis worked for small cap stocks. The results are quite different (left). Overall, the resulting portfolios show far lower returns and higher volatility than for large caps, with the worst performing portfolios being those comprised only of stocks in D1-D10 (left). D2-D9 was second best, perhaps meaning the distribution was not really that meaningful. However, avoiding the extreme deciles is clearly important, a stark contrast to large caps. Hit rates for the extreme deciles were modestly lower than hit rates for stocks selected from betas closer to the middle of the distribution (right).



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